1 Purpose

To provide students with one of three levels involvement with the subject content: to explore the unique aspects of each (chemical, biological and radiological) threat, to introduce concepts of building design for threat mitigation; to apply the concepts in a real world situation. Each is to be engaged in one of three sequenced class sessions.

2 Duration of Lesson

50 Minutes for each session (one per day)

3 Additional Topics

None

4 Objectives

To frame a broad awareness of chemical, biological and radiological contamination.
To develop a specific understanding of building-related interior/exterior contaminant dispersal.
To demonstrate an ability to identify and thereby avoid potential weak points (targets of opportunity) in a building design.

5 Standards & Benchmarks

Identify the pathogens that cause plant diseases and explain their development.

Students shall identify and explain the safety procedures used in the handling and application of horticultural chemicals. **LM.A 5**

Identify the different methods by which pesticides can enter the human body. **LM.A 5.1**

Identify the methods of accidental poisoning which can occur due to exposure to pesticides. **LM.A 5.2**

Identify the major ways in which humans can be exposed to pesticides. **LM.A 5.3**

Recognize the proper procedures for the disposal of pesticides. **LM.A 5.10**

Recognize the effect of pesticides on our groundwater and the types of pesticides that contribute to its contamination. **LM.A 6.3**

Outline various ways to avoid groundwater contamination and help the environment when using pesticides. **LM.A 6.4**

SCIENCE

ADVANCED ENVIRONMENTAL SCIENCE:

Students investigate, through laboratory and fieldwork, the concepts of environmental systems, populations, natural resources, and environmental hazards. **ENV.1**

Understand and explain that waste management includes considerations of quantity, safety, degradability, and cost. Also understand that waste management requires social and technological innovations because waste-disposal problems are political and economic as well as technical. **ENV.1.31**

Describe some of the ways in which plants defend themselves against pathogens and insects. **PS.5.13**

BUSINESS, INFORMATION & MARKETING TECHNOLOGY

BUSINESS TECHNOLOGY LAB:

Students understand and apply the fundamentals of ergonomics and business/personal safety. **BTL.2.5**

Use ergonomic principles to maximize performance. **BTL.2.5.1**

Demonstrate proper safety procedures. **BTL.2.5.2**

TRADE AND INDUSTRIAL EDUCATION

BUILDING AND FACILITIES MANAGEMENT:

Students maintain facilities by performing servicing and cleaning tasks and repairing mechanical systems. Appropriate tools, equipment, supplies, and chemicals are selected to complete building management operations. **BFM.3**

Assess and implement proper safety practices. **BFM.3.16**

Example: Use protective clothing. Example: Properly mix, store, and dispose of chemicals and paints.

HEALTH CAREER EDUCATION

INTEGRATED HEALTH SCIENCES I:

Relate the effects of various pathogens to diseases of the body systems. **IHS1.8**

Describe differences between classes of pathogens. **IHS1.8.1**

Relate pathogens to disease. **IHS1.8.2**

IHS1.8.3

6 Vocabulary

- Chemical- Classical chemical warfare agents include a wide variety of different compounds that can affect humans in various ways. Chemical warfare agents commonly exist as either a gas or liquid aerosol.

  Symptoms resulting from exposure to chemical agents tend to occur quickly. Most chemical warfare agents (gases) are classified by their physiological effects, e.g., nerve, blood, blister, and choking. Toxic industrial chemicals (TICs) can also elicit similar types of effects.

- Biological- Biological Agents such as Bacillus anthracis (anthrax), Variola major (smallpox), Yersinia pestis (bubonic plague), Brucella suis (brucellosis), Francisella tularensis (tularemia), Coxiella burnetti (Q fever), Clostridium botulinum (botulism toxin), viral hemorrhagic fever agents, and others have the potential for use in a terrorist attack and may present the greatest hazard.

  Symptoms associated with exposure to biological agents (bacteria, viruses) vary greatly with the agent and may take days or weeks to develop. These agents may result in high morbidity and mortality rates among the targeted population.

- Radiological Radiological hazards can be divided into three general forms: alpha, beta, and gamma radiation. These three forms of radiation are emitted by radioisotopes that may occur as an aerosol, be carried on particulate matter, or occur in a gaseous state.

  Symptoms from exposure to ionizing radiation can include both long- and short-term effects.

- HVAC (Heating Ventilation and Air-Conditioning) A baseline HVAC system shall include the following systems and components:

  • Dedicated Outdoor Air Ventilation Systems

  • Floor-by-Floor Air-Handling Units

  • Perimeter and Interior Heating and Cooling Systems

- DOAVS (Dedicated Outdoor Air Ventilation Systems) The building shall have dedicated 100-percent outdoor air ventilation systems (DOAVS) sized to meet both the ventilation and pressurization requirements of the building. These physically secure, vertically zoned systems shall provide tempered dehumidified outdoor air to the occupied spaces by either of the two following methods depending on the specific application, the perimeter heating and cooling system proposed, and building configuration:

  • Use a dedicated 100-percent outdoor air ventilation distribution system ducted directly to the occupied spaces, or

  • Use a dedicated 100-percent outdoor air ventilation distribution system ducted through an air flow control device (air flow measuring station) to the return side of the floor-by- floor air handling units. In this case, the system shall be provided with a means of bypassing the floor-by-floor air-handling unit during unoccupied hours.

7 Materials

Computer in classroom with internet connection; Audio and Video Output Devices for the Computer; In-class Worksheets and Handouts.

8 Additional Resources

None.

9 Procedures & Methods

A. Introduction

Security and safety measures, such as those for anti-terrorism and force protection (ATFP), must be considered within a total project context, including impacts on occupants and the environment, regardless of the level of protection deemed appropriate. This includes the consideration of impacts to the facility HVAC systems in general, and those systems interacting with the building envelope specifically. Of particular concern are airflow patterns and dynamics both inside and outside of buildings, especially pertaining to the internal release or external release of chemical, biological or radiological contaminant, and the measures necessary to limit airborne contamination.

B. Development

Day 1___Students are divided into three groups and are asked to prepare three respective presentations on the distinction of chemical, biological or radiological contaminants.

Students are divided into three groups and each asked to use the referenced sources to assemble a short presentation on the respective typical means of threat delivery in or near an airport terminal. Students may choose an airport in any city. The teacher may want to limit choices by assigning airports or assigning different kids of airports (international airports or regional airports, for example)

C. Practice

Day 2___Students are divided into three groups and are asked to prepare three respective presentations on the distinction of chemical, biological or radiological contaminants.

They should discuss the order of magnitude of the threat (kill potential) as compared to the amount of the contaminant (a drop, a pound, a gallon, etc.) and the related sizing and character of the delivery device (matchbox, backpack, suitcase, etc.)

D. Independent Practice

Day 3___Students are asked independently to select one of the contaminants and to imagine (as if they were a terrorist) where and how they could try to introduce the contaminant in their chosen airport. They should share their thoughts with classmates to see how many common vs. unique ideas the class can find.

E. Accommodations (Differentiated Instruction)

Some students may be most skillful researching the scientific basis and technical aspects of a respective CBR threat and its mechanism of human incapacitation.

Some students may be most comfortable with diagramming the physical layout of the airport and locating points of vulnerability to CBR threats.

Some students may have a natural affinity for illustrating the techniques in an airport heating and cooling air handling/air flow system.

Some students might be most adept at organizing a team presentation and writing/editing the narrative of the team report to be made to the rest of the class.

F. Checking For Understanding

No matter what distinctive task a student embraces as a team member and as an individual she/he should be able to demonstrate a comprehensive understanding by the recount and summation of all that has been presented by all three teams. Comparing and contrasting the various methods forces students to use critical thinking skills.

G. Closure

Students should document their experience in final report form, including annotating their rationale for the diagnoses, recommendations and modifications.

10 Evaluation

Students are to be evaluated on the clarity with which they present the content of their reports, Including:

Concise but thorough writing;

Annotation of appropriately excerpted/constructed illustrations;

Logic and organization of the presentation;

Quality of the report formatting.

11 Teacher Reflection

To be completed after teaching the lesson.

12 Resources & Media

Computer in classroom with internet connection;

Audio and Video Output Devices for the Computer;

In-class Worksheets and Handouts

Federal Agencies

- Centers for Disease Control and Prevention (CDC)
- Department of Homeland Security (DHS)
- Federal Energy Management Agency (FEMA) All-Hazard Mitigation Program on Anti-Terrorism
- Federal Facilities Council (FFC) Standing Committee on Physical Security & Hazard Mitigationa

Publications

- Building Ventilation and Pressurization as a Security Tool, Andy Persily, ASHRAE Journal, September 2004.
- Building for a Secure Future, Engineering News Record and Architectural Record, March 2002.
- Building Security Through Design: A Primer for Architects, Design Professionals, and their Clients, The American Institute of Architects, Washington DC, 2001a
- Protection of Federal Office Buildings Against Terrorism, Committee on the Protection of Federal Facilities Against Terrorism, Building Research Board, National Research Council, Washington DC, National Academy Press, 1988.
- Uses of Risk Analysis to Achieve a Balanced Safety in Building Design and Operations, by Bruce D. McDowell and Andrew C. Lemer, Editors; Committee on Risk Appraisal in the Development of Facilities Design Criteria, National Research Council, Washington DC, National Academy Press, 1991.

Organizations

- The American Institute of Architects (AIA) Security Resource Center
- American Society of Civil Engineers (ASCE)
- American Society of Industrial Security (ASIS)
- Protective Glazing Council (PGC)
- Society of American Military Engineers (SAME)

ATTACHMENT #1

Provide a Tight Building Envelope

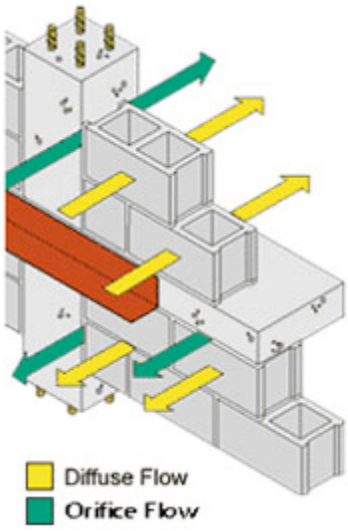

Figure 1. Air Leakage through a Building Enclosure

In traditional construction, infiltration occurs through gaps and cracks in the building envelope. Excess infiltration of cold air in the winter and hot humid air during the summer can create uncomfortable indoor environments and raise heating and cooling costs by 20% to 40%. Such unintentional infiltration is also a concern for an exterior chemical, biological, and radiological (CBR) release at some distance from a building, such as a large-scale attack. Decreasing infiltration improves comfort, saves energy, controls moisture, reduces indoor pollution, and makes forced ventilation necessary. Also, tight building construction in combination with building pressurization can be an effective CBR-protection strategy.

Commission Envelope Elements—the building commissioning process should include commissioning of the building envelope to insure that all performance requirements are being met. Commissioning of the building envelope can identify areas of concern related to air infiltration and leakage, moisture diffusion, surface condensation, and rain water entry—all issues that can negatively impact the building's energy performance and indoor environmental quality. Of particular importance is to begin commissioning of the building envelope during design when design modifications can be easily incorporated, rather than waiting until construction when remediation can cost significantly more.

While the LEED® Green Building Rating System requires buildings to undergo Fundamental Building Commissioning of systems to achieve certification, it merely recommends that some form of building envelope commissioning be incorporated. Lemieux and Totten have proposed a Building Envelope Commissioning process that could supplement the Fundamental Building Commissioning required for LEED® certification.

ATTACHMENT #2

Incorporate Dedicated Ventilation and/or Exhaust Systems

Exposure of building occupants to potentially hazardous chemical, biological, and radiological (CBR) agents negatively impacts the indoor environment and can pose serious health threats. To help maintain superior indoor air quality and protect people's health, dedicated ventilation systems (aka. dedicated outdoor air ventilation systems [DOAVS]) and dedicated exhaust systems can be installed. DOAVS use separate air handlers to condition and deliver the minimum required constant volume of outdoor air. Be sure to protect all outdoor air intakes and locate away from all exhaust openings. For more information, see the Department of Health and Human Services' Guidance for Protecting Building Environments from Airborne Chemical, Biological, or Radiological Attacks, May 2002 and Guidance for Filtration and Air-Cleaning Systems to Protect Building Environments from Airborne Chemical, Biological, or Radiological Attacks, April, 2003.

ATTACHMENT #3

Consider the Physical Security of HVAC Components

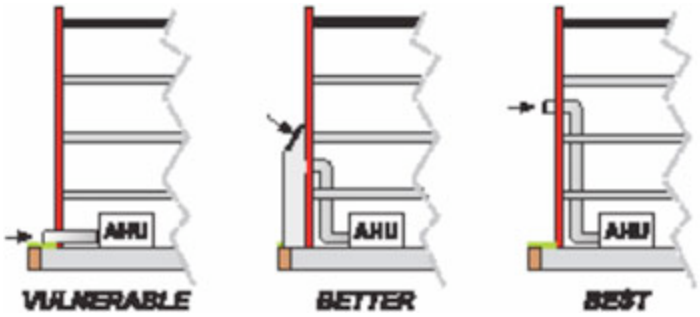

Figure 3. Protecting Outdoor Air Intakes

(Courtesy of Guidance for Protecting Building Environments From Airborne Chemical, Biological and Radiological Attacks, NIOSH)

Outdoor Air Intakes—One of the most important steps that can be taken to protect a building's indoor environment from CBR attack is the security of outdoor air intakes. Introducing CBR agents into outdoor air intakes allows for the dispersion throughout the building via the HVAC system. Intakes at or below grade are most at risk due to their accessibility and because most CBR releases will be near the ground and remain there. Locate outdoor air intakes above the third floor of the building, and preferably at roof level whenever possible.

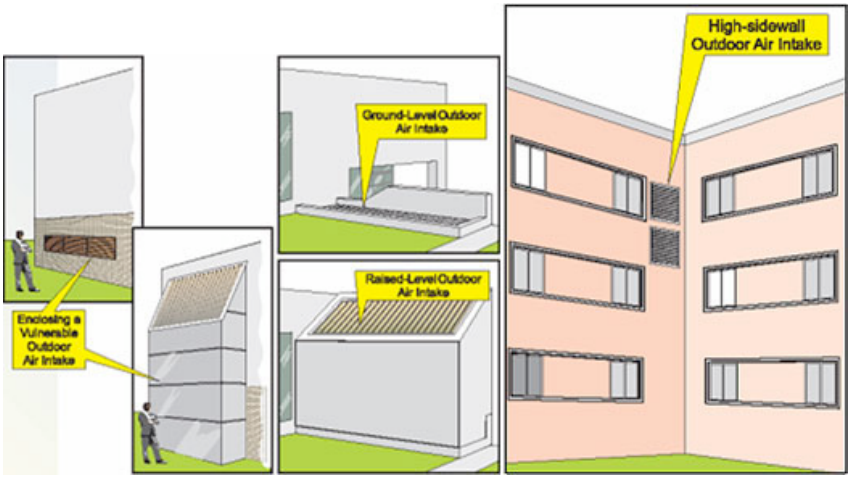

Figure 4. Vulnerable Outdoor Air Intakes

(Courtesy of Guidance for Protecting Building Environments From Airborne Chemical, Biological and Radiological Attacks, NIOSH)